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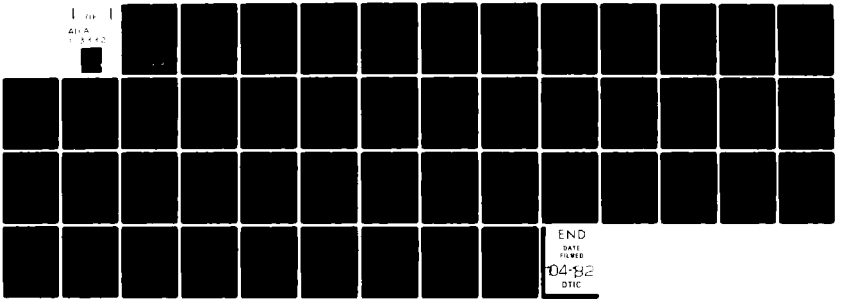

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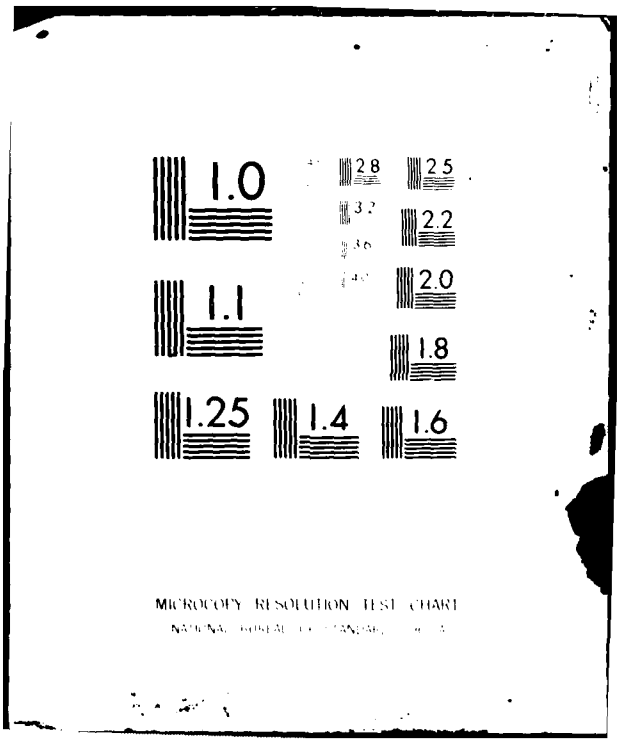
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WAGE DETERMINATION IN JAPANESE MANUFACTURING: A REVIEW OF RECENT LITERATURE

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ABSTRACT

This paper surveys the Japanese literature on wage determination, highlighting the debate between institutional and human capital explanations of interfirm wage differentials. Both approaches predict (and find) that years of tenure in the current firm are more highly rewarded than outside experience, but do not explain adequately the systematic differences in this valuation of experience across industry, firm size and occupation. An alternative hypothesis linking technical change to skills and wage differentials is reviewed and shown to be supported empirically.

A

INTRODUCTION

There is a substantial body of research on wage differentials in Japan focusing, in particular, on firm size wage differences and the institutionalised wage and employment practices of large enterprises. Not only have these firm size differentials persisted since the turn of the century, but they also appear to be large in comparison to differentials found in developed western countries. In the mid-1960s, mean monthly wages in small manufacturing firms employing 10-49 workers were about 55 percent of that in large firms with over 1000 employees. Comparable figures for the United States and West Germany in 1967 were 74 percent and 70 percent, respectively.[1]

This literature is of considerable interest to non-Japan specialists for several reasons. Firstly, the ways in which this problem has been conceptualized are of analytic interest. One approach emphasises the institutional and structural factors which, it is argued, give rise to these segmented labour markets; a second, and more recent, approach discounts the importance of market imperfections and views these phenomena as outcomes of varying investments in firm-specific skills. Secondly, the Japanese evidence suggests that the traditional research focus on wage level differences (typically measured by including firm size and industry dummy variables in wage models) is not particularly revealing of how reward structures differ across firms and industries. Mean wage differentials across firms appear to be

systematically related to differences in the valuation of experience (variously measured by age, years of labour market experience or job tenure) accumulated in the firm of current employment and elsewhere. Finally, there is a growing body of evidence that firm size wage differentials and long-term jobs are also important in other national economies.[2] What insights, if any, might be gleaned from research on seniority wage payments and lifetime employment practices in Japan?

This paper critically surveys recent studies on the determinants of Japanese wage structure with an emphasis on the contributions of the human capital approach. In Section I, the background to the main research emphases in the earlier Japanese literature is laid out. Section II describes the earlier debate between the institutional (for example, the nenko or seniority-based system of promotion and wage determination) and human capital explanations of firm size differences in wage structure. Section III outlines several studies which stress firm-specific training and the optimising behaviour of workers and firms as determinants of Japanese wage structure, bonus payments and other forms that resemble the institutional practices of nenko and permanent employment. From the empirical results of various studies, Section IV derives comparable estimates of how skills acquired in the current firm are valued relative to their shadow price in the external market, and notes that these findings are equally consistent with both competing hypotheses. In Section V, the contribution of several studies which link technical change to skills and wage differentials is reviewed.

I. BACKGROUND

In explaining the magnitude and persistence of firm size and other wage differentials in Japan, some scholars stress the importance of tradition and sociocultural factors. Inter-firm wage differentials are said to arise because paternalistic forms of industrial relations are more institutionalised in large than in small firms (Abegglen 1960; Funahashi 1975). In another view, large firms offer high wages and fringe benefits to compensate for the loss of paternalistic benefits available only to workers in small firms (Yasuba 1976). However, there is evidence that the present forms of these institutional practices are relatively recent phenomena, dating from about the end of the inter-war period (Taira 1970). Further, seniority benefits in employment and wages are limited to 'regular' employees in large firms. Temporary workers and many females are not covered and are often laid off in adverse economic conditions. These institutional practices are less institutionalised in small firms presumably because economic considerations, such as higher bankruptcy rates or lower rates of unionisation, dominate these sociocultural factors.

The second set of hypotheses is quite diverse but may be loosely termed 'structural.' In these essentially economic explanations, wage differentials arise and persist because of market imperfections and disequilibrium factors. They draw attention to trade union activism, oligopolistic product markets, capital market imperfections, technologically determined factor proportions and conditions of surplus

labour.

Union pressure has been hypothesised as a cause of inter-industry and firm size wage differentials. Evidence presented in support of this explanation by Taira (1961, 1975), Ohtsu (1970), and Ono (1971) does not allay doubts that the true 'union effect' on wages has been isolated from other variables (for example, quality of labour inputs and other productivity-related characteristics of firms) correlated with the degree of unionisation. Enterprise unions may have inhibited the equalisation of inter-firm pay differentials in the postwar period but are clearly not an explanation for the emergence of firm size differentials. Odaka (1967c) argues that unions were quite weak in the prewar period and were organised mostly in small and medium size firms.

Another line of argument is that imperfections in capital markets, and discriminatory credit rationing in favor of large firms resulted in the choice of more capital-intensive techniques by large-scale enterprises (Shinohara 1961). An alternative to this 'capital concentration' hypothesis is that the factor proportions required for modern, large-scale production were technologically determined. In this way, a technology-induced dualism arose between the large-scale modern sector based on imported foreign technology and the traditional sector of small firms using more labour-intensive traditional techniques (Watanabe 1968). In both explanations, the resulting differences in labour productivity are said to be the cause of wage differentials. However, there are no a priori grounds which suggest why higher average

labour productivity should be associated with different wage levels if it can be assumed that labour is homogeneous and labour markets competitive. A rational firm would have little incentive to pay higher wages unless there are concurrent factors, institutional or otherwise, which prevent wages from being equalised. Labour heterogeneity, institutionalised immobility of workers, or union pressure varying by firm size are possible explanations. Therefore, imperfections in both product and factor markets, or alternatively, unmeasured labour quality differences are necessary to this conclusion.

The permanent employment and high wage practices in large firms have been interpreted as institutional responses to shortages in skilled labour which emerged in the early phases of industrialisation (Odaka 1967c; Koike, 1977). To minimise turnover, especially of skilled labour, workers were recruited for life and guaranteed wage increases with seniority and age (nenko). One suggestion is that life-cycle related 'living costs' were important in determining the pattern of rising wage payments with age (Umemura 1967; Sumiya 1974). A question that arises is why these institutional practices have persisted into the postwar period when, presumably, skill shortages have eased. One possibility, reflected in the work of Minami (1972), is that nenko and permanent employment have been sustained by conditions of labour surplus. It is said that while wages in general are kept down to institutionally determined levels by conditions of labour surplus, high wage and employment practices persist in large firms because of

tradition and custom, union pressure for employment security (Galenson and Odaka 1976) and ability-to-pay considerations (for example, monopoly rents or high average labour productivity). The tendency for inter-firm wage differentials to narrow in the early 1960s has been interpreted as a movement to a more competitive labour market with the ending of labour surplus conditions.

Blumenthal (1966) investigates this hypothesis, using the analysis of variance approach to estimate a wage model for three cross-sections from the Basic Wage Survey: 1958, 1961 and 1964. The explanatory variables--schooling, age, firm size, sex, occupation, their interactions and dummy variables for two-digit manufacturing industries--are all entered in dummy variable form. The results suggest that there was a reduction over the whole period in the age and firm-size wage differentials with which nenko practices are most closely related, and especially for younger workers up to age 29, a reversal of differentials, with workers in small firms receiving higher wages than their counterparts in large firms. Important industry effects on wages are also found. He then tests the hypothesis that movement to a more competitive labour market breaks down the link between wages and average labour productivity, so that inter-firm wage differentials might be expected to disappear over time. Regressing industry value added per worker on the estimated industry effects, he finds some support for his hypothesis: Both R^2 and the positive coefficient of the productivity variable decline over time.

Using the same approach, but controlling more carefully for hours worked, bonus payments and both age and internal experience in the current firm, Tachibanaki (1975) extends the period of analysis to 1970. He finds little support for Blumenthal's prediction about the progressive reduction in firm size wage differentials over time. While firm size wage differentials have declined somewhat, these effects appear to be cyclical, narrowing in the early 1960s but subsequently becoming more important in the latter part of the decade. More recent research by Nakamura (1978a) confirms that important firm size and inter-industry wage differentials have persisted into the 1970s.

The surplus labour hypothesis is most pertinent for investigating how the dispersion of wage differentials changes over time, rather than why there are wage structure differentials. Even then, the necessity of such an assumption is questionable. Consider a model where, for whatever reason, labour markets are segmented into high-wage and low-wage firms.[3] Cyclical variations in economic activity can lead to a narrowing or widening of wage differentials. In an economic expansion, high-wage policy firms are able to meet labour requirements without increasing wages; on the other hand, low-wage policy firms have to raise wages to compete for workers. Tachibanaki's findings are consistent with the predictions of such a model but, nonetheless, leave unanswered the question of why there is labour market segmentation. The remainder of this survey therefore focuses on the determinants of wage structure differences.

II. HUMAN CAPITAL VS NENKO: THE EARLY DEBATE

Following Becker's (1964) seminal work, several studies have attempted to distinguish empirically between human capital and nenko explanations of wage structure differences between large and small firms. Two issues are important. First, does nenko, with its stress on the primacy of years of seniority in wage determination, operate to undervalue skills acquired elsewhere? Second, do large firms where these institutions are most entrenched pay wage premiums that cannot be accounted for by workers' productivity characteristics? The Napier and Stoikov studies are of considerable interest for they arrive at very different conclusions.

Stoikov (1973a) hypothesises that if nenko-related wages are the norm in Japan, then experience gained outside the firm would have a negligible effect on wages. On the other hand, if external and internal experience are substitutable to a large degree, then this would support a human capital interpretation of wage determination.[4] Using 1967 data from the Basic Wage Survey, he estimates a common wage model for the whole sample of male workers in manufacturing, but allows firm size effects to be captured by firm size dummy variables. He finds that the returns to an extra year of internal experience (2.18 thousand yen) are very similar to those from other work experience (1.68 thousand yen), suggesting that the two kinds of experience are close substitutes. Though firm size dummy variables are significant, he discounts their importance since they account for only 10 percent of explained wage

variance. The remaining 90 percent is explained by human capital variables: schooling, both kinds of experience and their interactions.

It may be argued that Stoikov's procedure is not a direct test of the competing institutional hypothesis. Implicit in his wage model is the assumption that worker attributes are equally rewarded across firms so that any wage differentials are reflected only in firm size intercept differences. In other words, he constrains to be equal precisely those firm size differences in returns to internal experience predicted by the nenko hypothesis.

The significance of firm size differentials in wage structure is confirmed by Napier (1974). Using data from the 1970 Basic Wage Survey, he estimates separate wage models for each firm size population and, on the basis of a Chow test, rejects the null hypothesis that there are no firm size differences in returns to work experience. Next, with the coefficients estimated for each firm size, he computes the adjusted mean wage of workers in small firms, assuming they had the same human capital attributes as their large firm counterparts. Comparing the unadjusted and adjusted ratio of small to large firm wages (73.1 and 77.6 percent), he concludes that only 16.7 percent of firm size wage differentials can be explained by differences in human capital attributes. The remaining 83.3 percent he attributes to the operation of nenko and other institutional factors.

Napier's conclusions are premature for several reasons. First, simply demonstrating that considerable unexplained variation in wages

exists, without relating them to underlying causal factors, is not particularly revealing. Residuals represent many poorly understood factors, as well as measurement problems or uncorrected differences in ability. Second, his finding of numerically larger returns to internal experience in large than in small firms is also consistent with another human capital hypothesis based on firm-specific training. If large firms invest more in skills which make workers more productive in the current firm than elsewhere, these firm-specific training returns will be reflected in internal experience coefficients that increase with firm size. A final point concerns his finding of significant negative returns to external experience in all firm sizes. Taken at face value, this result implies that job change will be concentrated in the first few years in the labour market since increased work experience is associated with absolutely lower wages in alternative employment. Though this phenomenon may be explained by institutional practices such as collusive agreements by large firms not to pirate each other's workers, it appears to be inconsistent with observed higher labour mobility among small firms. These last two points are discussed further in Section IV.

In a second study, Stoikov (1973b) reports the results of estimating two different wage models, one including large and medium firm size dummy variables, the other firm size dummy variables and their interactions with both internal experience (IE) and external experience (EE). In the first specification with just firm size intercepts, that

is, when IE is constrained to be equal across firm sizes, workers in large firms receive an average wage premium of over four thousand yen compared to employees in small firms. Inclusion of firm size dummy interactions with IE and EE in the second specification causes the firm size intercepts to change signs. Workers in large firms now have 'starting wages' 3.6 thousand yen lower than those in small firms. However, holding external experience constant, each year of IE narrows this gap by 0.6 thousand yen. The result is an earnings differential in favor of employees in large firms after six years.[5]

Nevertheless, Stoikov argues that no monopoly rents accrue to employees in large firms since the present value of net gains to large firm employees (calculated at a discount rate of 15 percent) amounted to less than 5 percent of the average worker's annual earnings. It is not, however, conceptually correct to compare present values with undiscounted earnings. A more appropriate comparison is relative lifetime earnings in large and small firms, in which case, lifetime earnings in large firms are 18 percent higher.[6] These wage structure differences across firm sizes are therefore not illusory.

III. FIRM-SPECIFIC TRAINING MODELS

The emphasis of more recent human capital studies has changed. The concept of firm-specific training is developed more rigorously to provide insights into how the optimising behavior of firms and workers can give rise to interscale wage structures and employment relations

that resemble several aspects of the nenko and permanent employment practices.[7] Unlike much of the research reviewed earlier, these models start from the basic proposition that labour markets are competitive, and that firms and workers are profit-maximisers. Further, they assume that workers and firms are heterogeneous: Schooling increases the efficiency (reduces the marginal cost) of job training, while large firms are more capable at producing skills because of superior equipment, managerial systems and access to capital markets.

Kuratani (1973) first models the nature of job separations when skills are partly firm-specific and partly general. The decision to quit depends upon the distribution of job offers, while fluctuations in product demand influence the firm's lay-off decision. A two-period model is used to determine the optimal sharing of investment costs and returns by employers and workers. After training, a worker receives a wage lower than his marginal product but higher than the potential wage in alternative employment and is therefore less likely to quit. The employer is also less likely to lay off the worker since he is collecting higher profits by paying wages less than marginal product. The net effect of increased investments in firm-specific skills is lower quit and lay-off rates with increased years of job tenure.[8]

Kuratani then demonstrates that competition will lead to the assortive matching of the most able workers with the most capable large firms.[9] The logic of this argument is that when skills are firm-specific, workers and employers will care about the other party's

efficiency in either producing skills or being trained since their share of returns depends upon the profitability of joint investments. Consequently, there is an incentive for both parties to seek out the most profitable match of capabilities. It follows that investment in specific training yields the highest returns for the workers who (i) have more schooling, (ii) are employed in large firms.

The aggregate evidence is generally consistent with the following predictions: (1) job separations decline with tenure as firm-specific skills are acquired, (2) workers with more schooling or who are employed in larger firms have lower levels of job separation.[10] To test the prediction that returns to schooling and internal experience increase with firm size, Kuratani also estimates a log-wage model that included schooling, both internal and external experience, firm size dummy variables and their interactions with the above variables. Though he finds larger returns for internal experience than for other work experience, firm-size related differences in coefficients are not statistically significant. The reason why these results differ from findings reported by Stoikov and Napier is not obvious.

Hashimoto (1979) investigates the nature of wage contracts associated with investments in firm-specific skills to analyse the system of bonus payments. Since the value of a worker's specific skills varies with fluctuations in product demand, there is likely to be bargaining between workers and employer over the magnitude of this change. Wage contracts will be flexible or of a fixed nature depending

upon whether the transaction costs associated with employer-worker bargaining are low or high. He demonstrates that wage flexibility helps both workers and employer protect future returns on their investments in specific human capital during cyclical fluctuations in product demand. Assuming that these transaction costs are low in Japan, he asserts that bonus payments (representing worker's share of specific training returns) introduce wage flexibility into wage determination.[11] This model therefore predicts that increasing profitability of investments in specific training leads to higher bonuses relative to base wages. Further, this ratio should exhibit greater cyclical variability for cyclically-sensitive industries and for workers with more firm-specific skills.

Hashimoto subjects the model to both cross-section and time series tests. Using data from the 1970 Basic Wage Survey, he estimates the following model:

$$\ln RBY = f(IE, S, FSIZE, AGE, IND)$$

where lnRBY = logarithm of the ratio of bonuses to monthly wages, IE = internal experience, S = schooling, FSIZE = two firm size dummy variables, and IND = industry dummy variables. The results are consistent with the model's first prediction. The bonus-wage ratio increases with IE as specific skills are accumulated, and with the profitability of investments in specific skills represented by schooling and firm size. The coefficient on age is negative, a result that is

interpreted to mean that chuto saiyo sha (mid-career hires) receive lower benefits than regular workers.[12] With data for two occupational groups in 15 two-digit manufacturing industries, he next estimates the cyclical elasticity of industry output and RBY for the period from 1959 to 1974.[13] The simple correlation between these two elasticity measures is positive and significant at the 10 percent level. The variability of RBY is also greater for more skilled (non-manual) than for less skilled (production) workers, as predicted by the model.

It is apparent that many of the predictions of the firm-specific training model--employment stability, wage contracts and bonuses, profit sharing and a higher valuation of internal experiences--resemble the nenko and permanent employment practices of large Japanese firms. Nevertheless, the specific training model is not easily distinguished from institutional explanations of inter-firm wage differentials.

IV. MODEL SPECIFICATION AND INTERPRETATION

In addition to differences in conceptual approach, another major source of contention among Japanese labor economists is the appropriate specification and interpretation of the wage model. In particular, which alternative measure of work experience--age, external experience or potential experience--should be included with an internal experience variable?[14]

There is agreement among institutional labour economists that higher returns to internal experience represent nenko-related wages,

payments which some (Taira 1970; Shimada 1978) have interpreted as economically rational. However, there is less consensus about how to specify the rest of the nenko wage model. Tachibanaki (1975) includes an age variable, interpreting rising returns to age as wage payments for life-cycle related 'living costs.' They stem, he argues, from employer paternalism and social expectations. Alternatively, lower relative returns to potential experience (Nakamura 1978b) or external experience (Shimada 1978) are interpreted as a lower valuation by employers of previous experience acquired by chuto saiyo sha, or mid-career hires, primarily for institutional reasons. Sano (1976) is critical of the ad hoc interpretations attached to these variables which, as defined, are so closely related.

Human capital interpretations of these differential returns to years of internal and other work experience are relatively more straightforward; they are hypothesised to represent returns to firm-specific and general skills respectively.[15] When training is completely general, a worker's marginal productivity is equalised in all firms. Consequently, work experience need not be distinguished from other work experience, and general training returns are captured adequately by a potential experience measure. On the other hand, firm-specific training increases a worker's marginal productivity more in the current firm than elsewhere. Therefore there will be an added productivity effect to internal experience over and beyond that for potential experience which will be translated into higher returns to internal experience.

Various studies also report estimates of the returns to various measures of other work experience which are very different: positive returns for age and potential experience variables (Tachibanaki 1975; Tan 1980) but mixed results for external experience. Using the same data set (years differ), Shimada and Napier find negative or insignificant returns for external experience while Stoikov and Kuratani find positive and significant returns.

These findings, and their interpretations, cannot be evaluated adequately because of the differing model specifications used. The following discussion establishes a framework for comparing alternative wage models, points out the problems of treating internal experience as exogenous, and summarises estimates of the actual (or implied) relative valuation of internal and external experience reported in several of these studies. An assessment of the *likelihood of finding negative* returns to external experience may be possible if relative returns are found to vary within a relatively stable range.

Consider a stylisation of the wage model typically used in human capital studies where schooling, squared experience terms and other variables are suppressed for expositional simplicity:

$$W = a_0 + a_1 TE \qquad (1)$$

where W = wage, and TE = potential experience. If age on entry into the labor force is known, then age can be used interchangeably with TE. Distinguishing between internal experience IE and external experience

EE, (1) becomes:

$$W = a_0 + b_1 IE + b_2 EE \qquad (2)$$

$$= a_0 + (b_1 - b_2) IE + b_2 TE \qquad (3)$$

which includes both internal and potential experience variables.

With homogeneous and perfectly mobile labour, competition ensures equalisation of returns to general skills acquired both in the current firm and elsewhere. Since $b_1 = b_2$, the expanded specification of (2) or (3) yields no added information over the simple model. When there is differential valuation of internal and external experience (or skills), wage models (2) and (3) provide a rough framework for reconciling estimates using different specifications of the 'other experience' variable. In wage model (3), the coefficient of IE, $(b_1 - b_2)$, provides a direct estimate of the higher value of experience acquired in the firm to the current employer, relative to all other potential employers. In wage model (2), the differential valuation is not identified, but the shadow price of internal experience in alternative employment can be inferred from the coefficient of EE, that is, b_2.

However, note that the implicit treatment of internal experience as exogenous in these wage models is not completely appropriate. Selectivity effects associated with employer-worker decisions about job tenure may obfuscate estimates of the true returns to experience in the firm. For example, consider Kuratani's assortive matching model in which employer and workers have imperfect information about each other

initially. Workers are screened continuously on the job and the employer may fire those whose productivity rises less rapidly with internal experience than some expected minimum. Over time, attributes of the firm are also revealed, and the more able workers may quit to take advantage of higher investment and earnings prospects offered elsewhere. The upshot of treating IE as exogenous in wage models is a predictable upward (downward) bias in its coefficients in more (less) capable firms. If selectivity effects are important, only part of the differential returns to IE may be attributed to specific training investments.[16] Nevertheless, no corrections for tenure endogeneity are feasible given the aggregated nature of data in the Basic Wage Survey.

With this caveat, b_1/b_2 can be calculated for male workers[17] using the regression results taken from the pertinent studies. Note that monthly wage is used as the dependent variable. Uneven reporting of sample means and differences in model specification made two adjustments necessary. Firstly, b_1/b_2 is evaluated at the mid-career point assumed, for convenience, to be at 17 years of internal experience. The shadow price of these skills may be inferred from b_2 evaluated at 17 years of EE (see model 2). Where age and internal experience interval dummies are used (Tan 1980; Tachibanaki 1975), model (3) suggests that b_1/b_2 can be calculated from the wage profiles of workers aged 35-39 with 15-19 years of internal experience.[18] Secondly, the coefficients of quadratic experience variables in Stoikov (1973a) and Nakamura (1978b) are incorporated in the calculation of b_1/b_2. In the other two studies,

non-linearities in wage effects are already reflected in the coefficients of experience interval dummy variables.

Given differences in sample year, degree of disaggregation by firm size, occupation and schooling, two points are suggested by Table 1. Firstly, interpreted as the price of skils in the current firm relative to their shadow price in the market, b_1/b_2 ranges between 1 and 2. Secondly, though there are exceptions, b_1/b_2 appears to be higher for more educated workers, personnel in managerial positions and larger firms. These two 'stylised facts' are evaluated in turn.

The stability of b_1/b_2, and the narrow positive range over which it varies, suggests that negative returns to external experience are implausible. The possibility that data and estimation problems are responsible for this finding cannot be ruled out. On conceptual grounds, this result is also incongruent with voluntary labour mobility unless it can be demonstrated that restrictive union policies or collusive producer agreements to inhibit labour mobility were particularly successful in depressing alternative employment wages. One way of assessing this position is to ask whether the postulated immobility of employees is based on the reluctance of large firms, in which institutional wage and employment practices are most entrenched, to accept workers with previous experience in other large firms.

Both Odaka (1967a) and Cole (1979) have investigated this issue. Moves between firms are described by transition matrices from origin firm size i to destination firm size j. Each cell in the matrix is the

Table 1

SUMMARY OF ESTIMATED RETURNS TO INTERNAL AND EXTERNAL EXPERIENCE (MALES)[1]

Author	Time Period	Group[2]	b_1/b_2	Comments
Stoikov (1973a)	1967	AGG		Table 1, p. 346
		JH	1.30	IE = 17 years
		HS	1.41	EE = 17 years
		UN	1.48	
Tachibanaki (1975)	1958	P	1.25	Appendix 2, p. 582 IE = 15-19 years Age = 35-39 or (TE = 15-19 years)
Nakamura (1978b)	1975	AGG		Table 3, p. 213
		JH	1.28	IE = 17 years
		HS	1.35	EE = 17 years
		UN	1.17	
Tan (1980)	1961	S		Table VI-5, p. 136
		M	1.57	IE = 17 years
		P	1.49	TE = 20 years
		L		
		M	1.87	
		P	1.65	

Note: 1. Manufacturing only.
2. Definitions of group are:
AGG = both administrative and production workers
M = administration workers
P = production workers
S = small firms (30-99 employees)
L = large firms (over 1,000 employees)
JH = junior high graduates
HS = high school graduates
UN = university graduates

ratio of actual to expected moves from i to j, and values greater (less) than 1.0 measure the extent to which mobility between firm sizes surpasses (falls short of) pure chance.[19] The main diagonal, where i = j, is particularly important--it measures the extent to which job changes are concentrated within the same population. They find that all cells in the main diagonal exceeded 1.0, suggesting that most moves are lateral job changes within the same firm size populations. They therefore conclude that there is little support for the notion that labour mobility is hindered by institutional forces.[20]

Odaka also finds that for broad industry groups, industry of initial employment is a good predictor of industry in which a subsequent job is located, patterns of mobility which are similar in both Japan and the United States. I have calculated similar transition matrices from the Employment Trend Survey of 1964 which indicate that these patterns of mobility are even stronger at the two-digit manufacturing level. This empirical regularity suggests that many skills may be industry-specific. Since workers have an incentive to move to firms where their skills are most useful (highly paid), we would expect inter-firm mobility to be concentrated within the same industry if skills are specific to particular industries.

The second stylised fact relating b_1/b_2 to worker characteristics and firm size is, as noted earlier, equally consistent with both human capital and institutional explanations. The evidence on inter-industry wage differentials and patterns of mobility suggest a possible basis for

distinguishing between the competing positions. In particular, can the industry effects reported by Blumenthal also be explained in terms of systematic differences in wage structure, that is, b_1/b_2? For example, nenko and human capital explanations may be distinguished by their predictions about the relationship between industry starting wages and subsequent wage growth. Plausibly, unions, nenko and other structural factors affect wages by raising wage levels, rates of growth with internal experience, or both. The human capital view is unique in predicting that the greater are investments in specific training, the lower are initial wages and the more rapid is subsequent wage growth. Stoikov's experiments with the two wage model specifications are suggestive. Recall that positive firm size effects are found when he constrains returns to internal experience to be equal across all firm size populations. However, an inverse relationship between starting wage and wage profiles appears when the coefficients of experience are allowed to vary across firm size, a finding that is consistent with greater investments in firm-specific skills in large firms. Some empirical support has been found in tests of this explanation of inter-industry wage differentials in United States manufacturing.[21]

Nevertheless, this human capital approach is not easily developed into an explanation of inter-industry wage differentials. First, it begs the larger issue of why firm-specific training requirements vary across firms. One possible explanation links firm-specific training to the rapidity of firm growth, and firms in different industries grow at

varying rates.[22] However, this hypothesis ignores a second conceptual shortcoming in the model: The competitive market apparatus used to clarify the sharing of specific training investments and returns provides no pricing mechanism for firm-specific skills since they are not traded in the market. Theoretically then, wage structure differences are interdeterminate, even with a theory to explain the distribution of firm-specific training across firms and industries. The nenko and internal labor market models have similar shortcomings, namely, little theory to explain why firms adopt different institutional practices, or what consequences these variations have for wage structure differences across firm sizes and industries.[23] An alternative approach of addressing these issues is discussed in the following section.

V. TECHNOLOGICAL CHANGE AND WAGE DIFFERENTIALS

Several recent studies, drawing upon the 'technology-induced dualism' hypothesis proposed earlier by Watanabe (1968), have taken a second look at how the process of technological change may give rise to wage differentials. This line of research has clarified (a) the nature of inter-temporal changes in firm-size wage differentials across industries, (b) skill investments and their relation to technical practices used by competitors and (c) the link between specific human capital and technical change.

Yasuba (1976) investigates the hypothesis that firm-size wage differentials in an industry increase with the induction of foreign

technology, but subsequently diminish with its diffusion. Mean firm-size wage differentials for several industries are standardised for sex, age, blue-collar composition and operating days, and then summarised by two measures: the coefficient of variation (to measure wage spread) and the size elasticity of wages (to measure the association of high wages and firm size). For four points in time from 1909 to 1951, he allocates industries to either a 'dualistic' or a 'homogeneous' industry category on the basis of these indices.[24] With information on which industries had purchased foreign technology, and when, Yasuba finds considerable support for this hypothesis. It is well documented that the period preceding World War I was a period of rapid foreign-induced technical change in textiles, and six of ten dualistic industries were textiles-related. For the late years, the dualistic industries are no longer concentrated in textiles, and in fact, for the wearing apparel and hosiery industries firm-size wage differentials narrowed in the face of generally widening trends. Iron and steel, bricks and tiles, and printing industries all experienced rapid technical change after World War II and appeared in the dualistic category. These findings suggest that firm-size wage differentials in dualistic industries may be linked to quasi-rents from the use of foreign technology by large firms, rents which disappear when technology is diffused to other firms, that is, when the industry becomes homogeneous.

The nature in which these quasi-rents are translated into higher wages however, appears quite complex. Yasuba hypothesises that if

workers and employers share these excess profits, both wages and profitability per unit of capital should increase with firm size. Instead, he finds an inverse relationship between firm size and profit rates. This leads him to speculate that large, and presumably more impersonal, firms accept lower profitability and pay higher wages to compensate workers for the greater paternalistic benefits available only in smaller firms. However, there are other explanations for the inverse relationship which do not have these implications for sharing arrangements. If profits are interpreted as a return to capital, lower profitability rates may reflect the capital-intensive nature of production in large firms, or alternatively, the effective cost of borrowing in capital markets where larger firms receive favourable treatment (Caves and Uekusa 1976). Odaka (1967, p. 52) argues that the reported profits of small firms may also be inflated by the inclusion of remuneration for management services.

Saxonhouse (1976) explores the reasons behind the high turnover of workers in the Japanese cotton-spinning industry at the turn of the century. He examines the hypothesis that employers had little incentive to retain workers since few productivity advantages were gained by increased tenure in the firm. He rejects this hypothesis: estimating a translog production function where parameters are explained by variables such as schooling, years of tenure and the number of trained engineers, he finds that increases in these variables had large productivity effects. He argues that the uniformity of technical practices in the

industry inhibited investments in workers' skills, since they were easily transferred to other firms.[25] Support for this hypothesis is found in the similarity of the output elasticity of labour and the share of wage bill in total output. This implies that workers were paid the value of their marginal product, in other words, that workers invested in and paid for, through lower initial wages, skills that were general in nature and therefore freely transferable after they were acquired.

These findings of Saxonhouse and Yasuba may be integrated as follows: Noting that much of the productivity gains from introducing a new technology come from making cumulative small modifications in it, essentially through a learning-by-doing process,[26] an important question facing firms is how to motivate workers' investments in learning and retain these more productive new skills. The firm can do this by sharing the cost of investing in workers' new skills, and by paying them higher wages out of that component of productivity that is specific to the innovating firm. Unlike firm-specific training models, skill specificity may arise not because skills are idiosyncratic to the firm per se, but rather because they are specific to particular technologies to which a firm may have exclusive access. This exclusivity is, arguably, both the source of quasi-rents (which give rise to wage differentials) and the reason why skills are imperfectly transferable (other firms with different (older) technologies are unable to use these skills fully). Competitive forces in the form of technology diffusion work to turn these specific skills into general (and transferable) ones

over time, in which case, quasi-rents and wage differentials disappear. However, continuous innovations and the generation of added new skills can impede this process such that wage differentials can persist for long periods of time.

This technology-specific skills model (Tan, 1980) predicts that the relative price[27] of specific skills increases with the innovative possibilities that a firm faces. This model is given empirical content by introducing a stylised fact of technical change, that is, that there are systematic inter-industry variations in innovativeness determined, in large part, by exogenous developments in the science sector.[28] Within an industry, large firms are likely to invest more in technology-specific skills for the reasons cited by Kuratani. Increased investments in these skills may also be required by the research and development (R and D) emphasis of large firms on more expensive and long-term projects.[29] Thus, the relative price of technology-specific skills is expected to increase not only with firm size but also with the industry rate of technical change. An integrated explanation is therefore provided for both the distribution and pricing of specific skills across firms and industries.

Tests of these hypotheses are restricted to a sample of workers from the 1961 Basic Wage Survey, comprising male employees in the 11 two-digit manufacturing industries for which independent estimates of industry rates of technical change are available from Saito (1973).[30] The first test investigates whether the structure of wages differs

systematically across several comparison groups: by firm size, technology level[31] and firm size-technology level comparisons. White collar and production workers are analysed separately to test for occupational differences in wage profiles. A common wage model is estimated for groups being compared but wage profiles are permitted to differ by interacting internal experience and age variables with a large firm or high technology industry dummy variable. The coefficients of internal experience and age are interpreted as returns to specific training and general training, respectively (see Section IV).

In each pair-wise comparison, F-tests suggest that specific training wage profiles are significantly steeper in large firms and in high technology industries (controlling for firm size), but only for production workers. Since white-collar personnel receive returns to internal experience that are, on average, much larger than that of production workers, this result suggests that employment in larger firms or firms in high technology industries is associated with greater incremental acquisition of specific skills for production than for white-collar workers. The reason may lie in the nature of tasks performed by these two groups: Managerial functions may be rather similar in all firms; on the other hand, the jobs of production workers are likely to depend upon the plant and equipment they operate. In small firms or low technology industries where machinery is more technologically standardised, routinised production activities mean that only very general skills are acquired. Conversely, the potential for

learning and developing new technical skills is increased in more innovative large firms or firms in high technology industries.

The second test concentrates on the sample of large firm employees. The wage model is estimated separately for several occupation-schooling categories of workers in each industry. From the estimated wage profiles, present values of specific training (ST) and general training returns (GT) are then calculated for each group of workers, assuming continuous employment in the same firm for 35 years. Saito's estimates of industry rates of technical change (TECH) and a set of variables representing competing hypotheses--product market concentration (CON), profitability (PR), the share of wage bill in value added (WB), and unionisation (UNION)--are regressed separately on ST and GT. The regression estimates are reported below:

$$ST = 8334 + 1496^{*}\ TECH + 677\ HS + 525\ JC + 4351^{*}\ UNI$$
$$- 11\ CON - 47\ PR - 36\ WB - 81\ UNION \qquad R^2 = 0.525$$

$$GT = 3917 - 233\ TECH + 826\ HS + 7088^{*}\ JC + 7076^{*}\ UNI$$
$$+ 23\ CON + 224\ PR + 77\ WB - 14\ UNION \qquad R^2 = 0.771$$

where HS, JC and UNI are dummy variables for high school, junior college and university completion, respectively, and an asterisk denotes significance at the one percent level. Empirical support for the technology-specific skills hypothesis is found in the positive and significant relationship between ST and TECH; evaluated at the mean, a 10 percent increase in industry rates of technical change is associated

with a 5.4 percent increase in ST. The proxy variables representing competing hypotheses were insignificant and often of the wrong sign. Furthermore, the absence of any relationship between TECH and GT suggests that the positive effects of technical change on wages work predominantly through its effects on specific training. In other experiments which considered the possible simultaneous determination of ST and rates of technical change, this positive relationship remained very robust.[32]

The conceptual model, by establishing a link between technical change and specific skills, offers a human capital interpretation of nenko and permanent employment practices. These institutions are viewed as developing in response to the exigencies of technological change. As Saxonhouse's study demonstrates, the nature in which imported cotton-spinning technology was rapidly diffused had the consequence of high labour turnover despite clear productivity benefits of increased tenure in the firm. By clarifying the property rights of both employer and workers to these efficiency gains, these institutions created a context in which to develop and retain these more productive skills. By viewing the emergence of nenko and permanent employment as demand-induced institutional change, it follows that where there was less need to develop technology-specific skills, these institutional practices did not arise or were not retained. This might explain why these institutions are confined to some segments of the labour force and are more pronounced in some firm sizes and industries than in others.

VI. CONCLUSIONS

This review has sought to digest the considerable literature on the nature and causes of wage differentials in Japan. It notes that many of these wage differentials are not illusory: Firm size and inter-industry wage differentials remain, even after controlling for a variety of worker characteristics. There are important differences in the main approaches to this question. Much of the early research in Japan has been structural in nature, seeking to explain how unionisation, imperfections in product and factor markets, the sociocultural bases for institutionalised wage and employment systems, and labour surplus conditions interact to inhibit equalisation of inter-firm wage differentials. More recent specific human capital approaches have sought to explain how the optimising behaviour of workers and firms gives rise to wage differentials and forms which resemble institutional wage and employment practices.

A main finding of Japanese research is that systematic variations in the relative valuation of internal and external experience exist across industry group, firm size and occupation. This finding brings into question the usefulness of the traditional focus on explaining wage level differences. The two competing approaches are also inadequate, lacking developed explanations for why firm-specific skills or institutional practices vary across firms. The link from technological change to skills and wage structure differentials is one way of resolving this dilemma. Evidence from Japan supports this model, but

similar analyses in other national settings are needed to generalise the result.

Japanese research on inter-firm wage differentials and institutionalised wage and employment practices has implications for research on long-term labour contracting. Increasingly, economists recognise that there are many reasons why long-term employment relationships with one firm are economically rational. These include the firm-specific skills hypothesis and models in which wage profiles are 'tilted' either to minimise agency problems or to attract high quality workers.[33] To date, few of these models have been empirically tested. A promising avenue for future research is to apply Japanese models to distinguish empirically between alternative theories.

FOOTNOTES

Preliminary versions of this paper were presented to seminars at the University of Washington and Australian National University. Helpful comments from Peter Drysdale, seminar participants, and an anonymous referee are gratefully acknowledged.

1. Handbook of Labour Statistics (1978), Table 158, p. 219. Note that these figures are unadjusted for differences in worker attributes or hours worked. In Japan, employees in small firms work longer hours than their large firm counterparts so that hours adjustments would actually magnify firm size wage differentials.
2. For example, Hall (1980) estimates that over a quarter of all workers in the United States are holding jobs which will last 20 years or more. Using data from the U. S. Current Population Survey of 1979, Mellow (1981) finds that workers receive a wage premium of 25 percent in large firms (over 1000 employees) compared to small firms with less than 25 workers, even after controlling for worker attributes.
3. For a discussion of models of this genre, see Okun (1973).
4. Stoikov points out that internal and external experience need not be perfect substitutes if firm-specific skills are important.
5. Note that an inverse relationship between firm size and starting pay has also been found by Blumenthal (1966) and by Tanaka (1964) in surveys on the starting pay of school leavers.

6. Calculated from estimates reported in Stoikov (1973b), Appendix, p. 405.
7. While the concept of firm-specific training is also used in internal labour market reinterpretations of nenko and permanent employment, the emphasis is different. Firm specificity of skills is merely used to justify the analysis of internal promotions, intra-firm wage structure and labour-management relations within closed markets in each firm. For example, see Doeringer and Piore (1971).
8. However, note that only part of this negative relationship between job tenure and quit and layoff rates may be due to specific training investments. In any nonhomogeneous population, those workers with a low propensity to change jobs will tend to have longer job tenure and vice versa (Jovanovich 1979, p. 973).
9. This assortive matching model is an extension of Becker's (1973) work, "A Theory of Marriage." Kuratani (1973) notes that this prediction is consistent with the observation that large firms in Japan actively recruit graduates of the most prestigious schools which presumably matriculate the most able students. Odaka (1967b) also speculates that large firms have been able to attract the best new school graduates through a high wage policy.
10. Similar micro-level findings are reported by Tominaga (1967) and Cole (1979) for samples drawn from the cities of Tokyo and Yokohama, respectively.
11. It is noteworthy that Hashimoto interprets bonuses as specific

training returns. While this differs from Kuratani's focus on the relative returns to internal and external experience, it is possible that both measures are picking up different components of specific training returns. Indeed, in specifications using wages plus bonuses, Kuratani finds that the relative differential in returns to internal and external experience is amplified by using a more inclusive wage measure.

12. Holding tenure (IE) constant, older workers are more likely to have joined the firm in mid-career. It is likely that mid-career hires receive lower benefits because they are given less firm-specific training, having a shorter length of time (until retirement) over which investment costs may be amortised.
13. The elasticity measures are the coefficients of GNP_t obtained by regressing $\ln Q_{it}$ (output of industry i) and $\ln RBY_{it}$ on $\ln GNP_t$ and a time trend, respectively.
14. Potential experience is defined as age minus age at entry into the labour force. External experience is the number of years in the labour force spent outside the firm of current employment, that is, potential experience minus years of internal experience.
15. The justification for a specific training interpretation of these returns is developed more rigorously in Chapman and Tan (1980, pp. 372-3).
16. See Jovanovich (1979) for an exposition of this issue.
17. Female labour force participation is often interrupted for marriage

and child-bearing so that measures of work experience such as age, potential experience or external experience are not likely to capture accurately the returns to actual work experience. Estimates for females are therefore excluded.

18. If age at entry into the labour market is assumed to be 20, then both IE and TE (where TE = age minus age at entry) are approximately 15 to 19 years.

19. Expected moves are defined as follows: the distribution of moves from i to j proportional to the distribution of total moves across i's that end up in j.

20. Note that firm-specific training models add little to our understanding of these patterns of inter-firm mobility. Firm-specific skills are idiosyncratic to the firm and therefore are dissipated by job change. Since the general component of skills is equally useful in all other firms, the model predicts that inter-firm moves will be random with respect to origin and destination firm size.

21. See Chapman and Tan (1980).

22. Hashimoto (1979, p. 1090) argues that as the growth rate of the firm increases, firm-specific skills become scarce relative to general skills so that investments in specific human capital become more profitable. This hypothesis is, however, not empirically tested.

23. Umemura (1967, p. 163) and Funahashi (1975, p. 4).

24. A dualistic industry must be in the upper half of industries ranked

by the coefficient of variation, and in the highest quantile of industries ranked by size elasticity. A homogeneous industry is one in the lowest quantile in terms of the coefficient of variation.

25. Saxonhouse presents documentary evidence that most spindles were supplied by a single English company, and that frequent technical cooperation and exchanges of engineers diffused best practice technology rapidly through the industry.

26. See Hollander (1965) for a discussion of the micro-evidence for this contention. The role of skilled labour in this learning-by-doing process is well documented for industry; see Schultz (1975) for an excellent review of the allocative efficiency of schooling hypothesis in agriculture.

27. In effect this is b_1/b_2, or the value of skills acquired within the firm relative to their shadow price in alternative employment.

28. Scherer (1965) finds empirical support for this assertion in his study of the output of patented inventions in the United States. Similarities in the ranking of U.S. and Japanese industries by their rate of technical change are interpreted by Watanabe (1968) as suggesting that the United States was probably the 'exogenous' source of new technologies for Japanese industry.

29. See the survey of R and D portfolios of Japanese companies by Nomura Research Institute (1978).

30. Saito's measure of technical change is derived from Cobb-Douglas production functions estimated using the 1960 Input-Output table of

Japan and time-series industry data for 1955-63.

31. Six industries were classified as high technology and five as low technology industries on the basis of Saito's measure of total factor productivity growth.

32. If investments in learning and modification of new technologies lead to increased productivity growth, a simultaneous model--ST being a function of technical change, and in turn, technical change being a function of ST and other identifying variables--may be more appropriate.

33. For example, see Lazear (1981) and Viscusi (1980).

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